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COMMONWEALTH OF VIRGINIA
DEPARTMENT OF CONSERVATION AND ECONOMIC DEVELOPMENT
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MAGNETOMETER STUDY IN THE LEESBURG QUADRANGLE

E. Clayton Toewe[1]

The Leesburg 7.5-minute quadrangle is located in east-central Loudoun County, in northern Virginia (Figure 1). A magnetometer study was made in conjunction with the preparation of a geologic map of the quadrangle (Toewe, 1966). Magnetic methods of geophysical prospecting are generally used in reconnaissance work in order to locate large-scale features such as bodies of magnetic material or to determine the configuration of large intrusive masses. Small-scale magnetic surveys, such as the study in the Leesburg quadrangle, are dependent upon the differential magnetic susceptibilities of the various lithologic units present within the area. The magnetic susceptibility of any rock is virtually in direct proportion to the percentage of magnetite and, to a lesser extent, ilmenite and pyrrhotite that the rock contains. In general, sedimentary rocks have a much lower average magnetic susceptibility than igneous or metamorphic rocks. Mafic igneous rocks have the highest susceptibilities; metamorphic and felsic igneous rocks have higher susceptibilities than sedimentary rocks, but are generally considerably lower than mafic igneous rocks. The average percentage of magnetite in each lithologic unit present in the Leesburg quadrangle was determined by thin-section analyses. The results are: Catoctin Formation, 9.7 percent; diabase, 6.5 percent; mafic pyroclastic rock, 6.5 percent; intermediate pyroclastic rock, 4.0 percent; felsic pyroclastic rock, 2.0 percent; Weverton Formation and Triassic sedimentary rocks (conglomerate, sandstone, and shale), 0.5 percent.

The Cambrian or Precambrian Catoctin Formation is the oldest rock unit exposed in the area; the principal lithology in the Catoctin is chlorite schist composed of chlorite, albite, epidote, quartz, actinolite, sericite, and magnetite. Massive metabasalt and coarse-grained epidosite units occur as minor lithologies in the Catoctin. The Catoctin is overlain, possibly unconformably, by phyllitic, laminated, and banded quartzites in the Weverton Formation of Cambrian age. These low-rank metamorphic Cambrian and Precambrian rocks are separated from rocks of the Newark Group (Triassic) in the Culpeper basin by a high-angle normal fault that was named the Bull Run fault (Keith, 1894, p. 356).

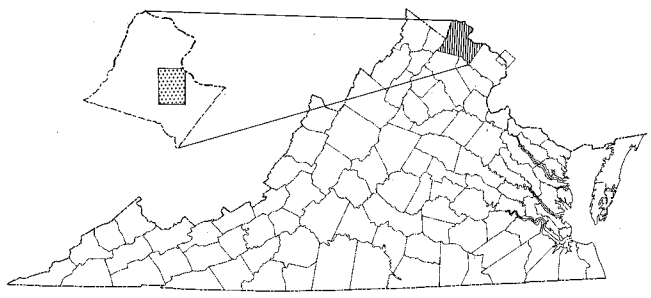
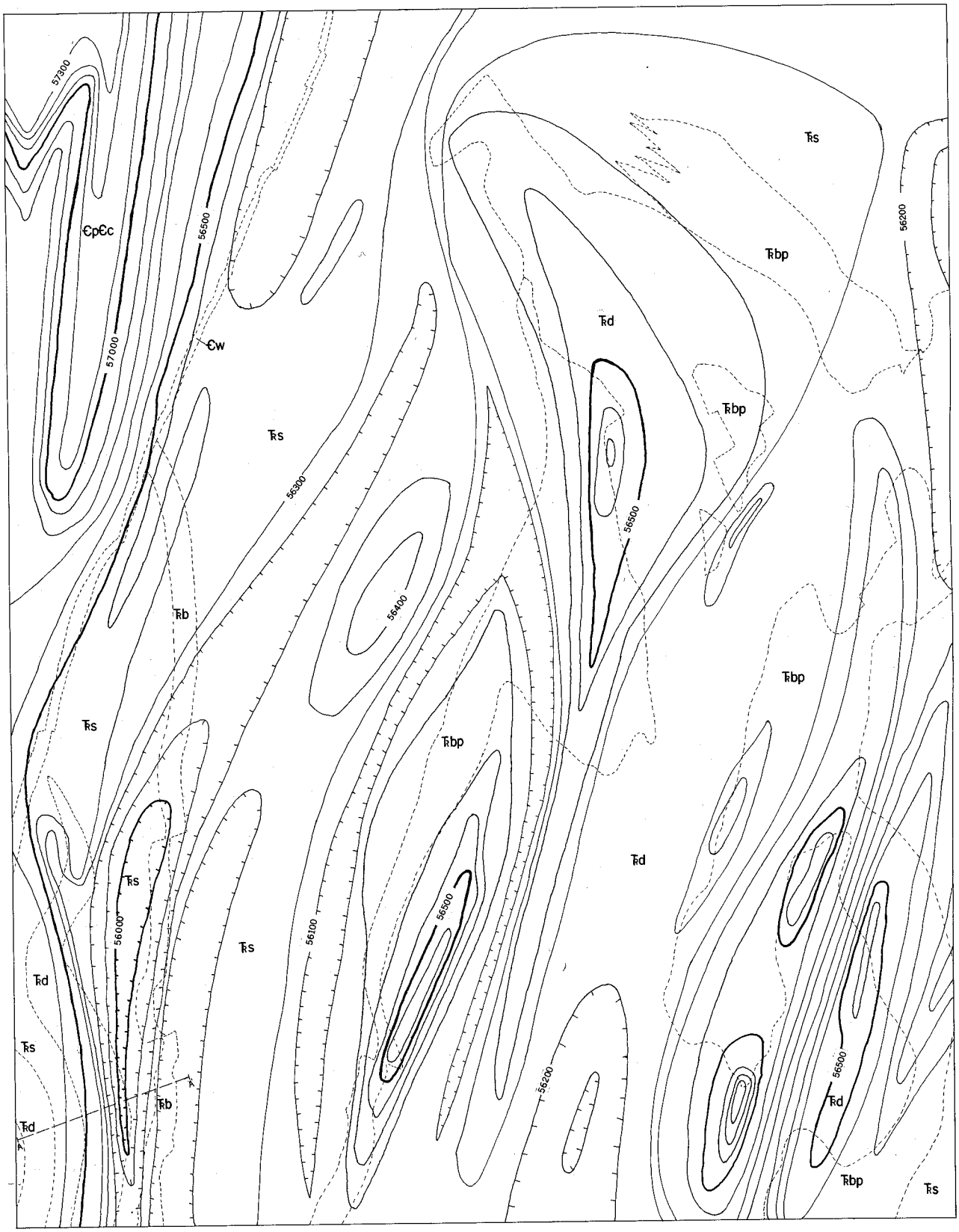


Figure 1. Index map showing location of the Leesburg quadrangle.

[1] Manuscript completed October 2, 1967, while Mr. Toewe was a staff member of the Virginia Division of Mineral Resources; his present address is: Battelle Memorial Institute, Columbus, Ohio.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Formation Boundary

The sedimentary rocks of the Newark Group are separated into four main units: conglomerate, including limestone conglomerate and quartz conglomerate; sandstone; shale; and eruptive volcanic rocks, commonly called pyroclastic rocks. These units interfinger with each other, and the entire volcanic-sedimentary sequence has been intruded by diabase sills. One vesicular basalt flow was mapped. Coarse-grained rocks are predominant in the Newark Group within the area. Limestone and quartz conglomerates, present near the border of the Culpeper basin, grade into coarse-grained sandstones, through medium- and fine-grained sandstones, into shales toward the center of the basin. This marked decrease in grain size, together with cross-bedding, is evidence of a western source for the Triassic sedimentary rocks. On the other hand, the pyroclastic rocks become thinner toward the north and west and interfinger with clastic sedimentary rocks, thereby indicating an eastern or southeastern source for this volcanic material.

The limestone conglomerate is an unsorted rock composed of angular to subrounded fragments of limestone, quartz, and various other rocks, ranging in size from 0.25 inch to several feet in diameter. These fragments are in a red matrix of quartz, clay, feldspar, calcite, mica, and chlorite. The quartz conglomerate is composed of subrounded to rounded pebbles and cobbles of quartz and quartzite, ranging from 0.25 to 6 inches in diameter, in a coarse-grained arkosic sandstone matrix. Red shales and sandstones are similar in composition; each contains almost equal amounts of quartz, plagioclase, and mica, with minor amounts of chlorite, epidote, calcite, pyrite, chalcopyrite, and magnetite.

The pyroclastic rocks have a wide variation in composition, ranging from felsic crystal tuffs of approximately dacitic composition, through intermediate crystal tuffs of andesitic or trachytic composition, to mafic crystal tuffs of basaltic composition. In general the basal units of the pyroclastic sequence are the most mafic, and grade upward into more felsic rocks. The intrusive Triassic diabase consists of pyroxene and intermediate to calcic plagioclase, generally labradorite. Magnetite and intergrowths of potassium feldspar and quartz are the accessory minerals; hornblende, sericite, chlorite, biotite, prehnite, calcite, chalcopyrite, pyrite, and zeolites are present as secondary minerals and/or alteration products. A basalt flow is present near the top of the Triassic sedimentary sequence. It is fine grained and composed principally of labradorite and pyroxene, with some magnetite and quartz.

Five east-west traverse lines were laid out across the quadrangle, at a spacing of 1 to 1.5 miles. Four of the lines extend completely across the quadrangle, but the central one covers only the middle one-third of the east-west distance. One hundred thirty instrument stations were set up, on approximately 0.25-mile centers; some stations were adjusted to follow roads in order to allow easier access, others were located on U. S. Coast and Geodetic Survey bench marks, and several were positioned in order to correspond with various geologic features.

The stations were occupied with a Varian model M-49A portable magnetometer that reads total magnetic intensity in gammas, which are units of field intensity. The diurnal variations of the earth's magnetic field are charted on magnetograms, continuous records of magnetic field variation at a given location; the magnetograms for the period of the survey of the Leesburg quadrangle were obtained from the Fredericksburg Geomagnetic Center at Corbin, Virginia. No significant magnetic activity was noted for this period, so it was considered unnecessary to correct the field readings for diurnal variation. Drift corrections were made by checking back to a base station several times during each traverse. The results of the survey are shown on Figure 2, which is a contour map of total magnetic intensity plotted on a base map showing the generalized geology of the quadrangle.

The regional trend of the bedrock is well delineated by the total magnetic intensity contours (Figure 2). Higher magnetic readings were obtained over the Catoctin Formation, the diabase, and the more mafic phases of the pyroclastic sequence. These high values are to be expected, in view of the percentage of magnetite in these rocks. The location of the Bull Run fault along the north-

Figure 2. Contour map of total magnetic intensity and generalized geologic map of Leesburg quadrangle. Explanation: €pЄc, Catoctin Formation; Є-Ow, Weverton Formation; Ŧ-Rd, diabase; Ŧ-Rs, undifferentiated Triassic sedimentary rocks, including limestone and quartz conglomerate, sandstone, and shale; Ŧ-Rbp, pyroclastic rocks, including mafic, intermediate, and felsic crystal tuffs; Ŧ-Rb, basalt.

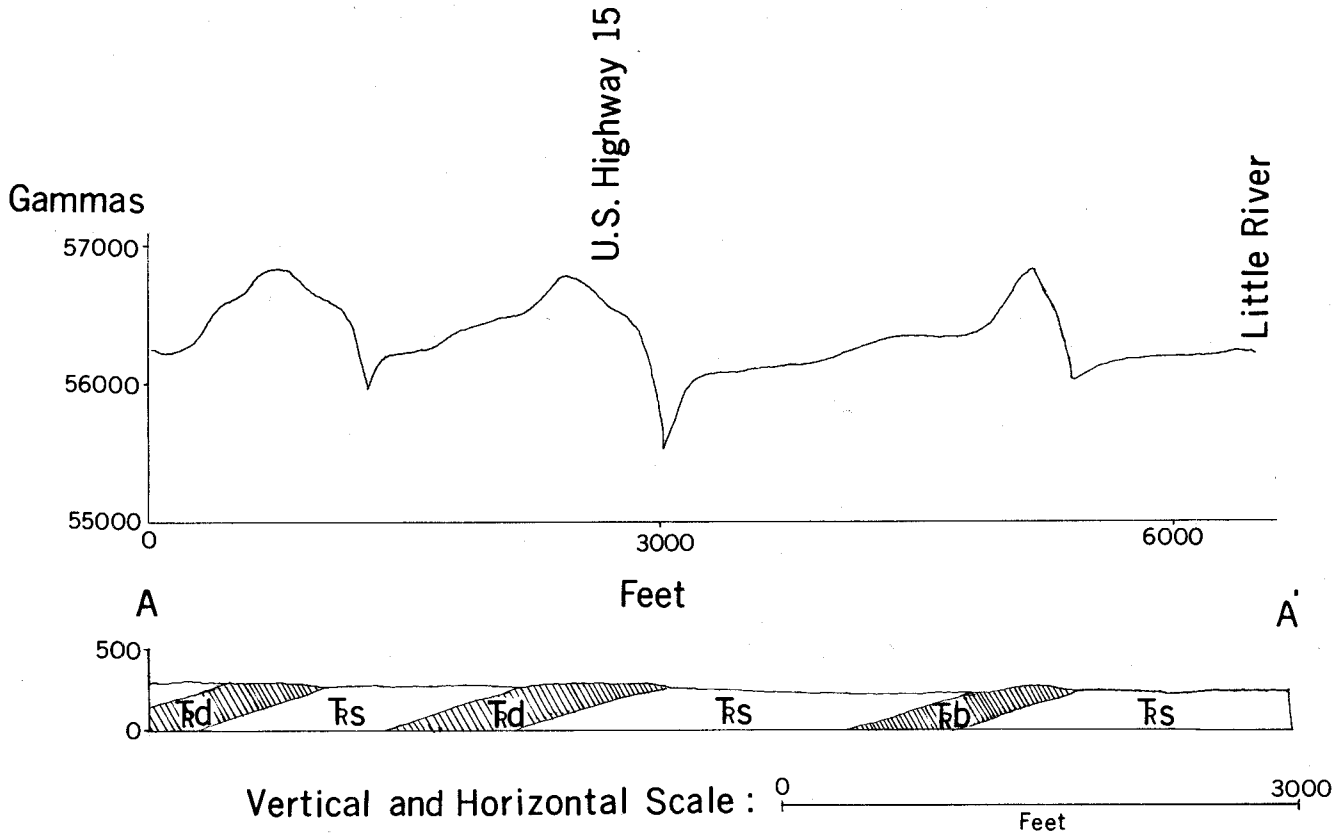

Figure 3. Total intensity magnetic profile and geologic cross-section along line A-A′ (Figure 2). Explanation: Trd, diabase; Trs, undifferentiated Triassic sedimentary rocks, including sandstone and shale; Trb, basalt.

west edge of the Culpeper basin can be approximately located on the magnetic map. A steep magnetic gradient exists between the Catoctin Formation, which has high values of total magnetic intensity, and the Triassic limestone conglomerate and the Weverton Formation, both of which exhibit relatively low magnetic readings.

In addition to the contour map, an east-west traverse, approximately 6000 feet in length, was made in the southwestern portion of the Leesburg quadrangle (Figure 2, A-A′) ; stations were located on 100-foot centers. This line crossed the vesicular basalt, two diabase sills, and intervening Triassic sandstones and shales. The magnetic profile obtained from this traverse and a geologic cross-section drawn at the same scale are shown on Figure 3. The actual contacts between diabase and sedimentary rocks cannot be determined by this method, but the magnetometer is a useful tool for locating approximate contacts in areas where there are few outcrops. The westerly dip of the mafic igneous rocks is indicated by the gradual increase in total magnetic intensity toward the east over all three of the igneous bodies. Higher magnetic readings are encountered where the basalt flow or the diabase sills are closer to the surface, reaching a maximum where these rocks crop out. Somewhat erratic magnetic values were encountered in areas of diabase outcrop; readings varied as much as 300 gammas in a circle with a 4-foot radius.

During the magnetic survey, a small area of anomalously low magnetism was noted over some of the diabase outcrops. A detailed survey was made of this anomaly that covers a circular area with a radius of 10 to 15 feet. Magnetic readings 3000 gammas below the average values for the area were obtained (Toewe and Le Van, 1966), and it was concluded that lightning was the most probable cause of the feature.

References

Keith, Arthur, 1894, Geology of the Catoctin belt: U. S. Geol. Survey 14th Ann. Rept., pt. 2, p. 285-395.

Toewe, E. C., 1966, Geology of the Leesburg quadrangle, Virginia: Virginia Division of Mineral Resources Rept. Inv. 11, 52 p.

Toewe, E. C., and Le Van, D. C., 1966, Anomalous magnetization in Triassic diabase near Leesburg, Loudoun County, Virginia: Geophysics, vol. 32, no. 3, p. 618-621.

OIL AND GAS DEVELOPMENT IN VIRGINIA DURING 1967

David M. Young[1]

A total of 3,827,447 Mcf of gas was produced in Virginia during 1967 compared to 4,249,340 Mcf for the previous year. Production in Buchanan County was 971,571 Mcf; Dickenson County, 574,046 Mcf; and Tazewell County, 2,281,830 Mcf. Oil production in Lee County amounted to 3491 barrels, a substantial increase over the 1073 barrels produced in 1966. The Rose Hill field accounted for 1870 barrels, and the Ben Hur field, 1621 barrels. Drilling activity increased considerably. Twelve wells in Chesterfield, Lee, and Tazewell counties accounted for a total footage of 22,069 feet. Few of these wells were completed as producers, and additions to developed reserves were negligible.

A total of 971,571 Mcf of gas was produced in Buchanan County during 1967 by the following operators: Ashland Oil and Refining Company, 716,199 Mcf; Cabot Corporation, 57,173 Mcf; P & S Oil and Gas Corporation, 55,697 Mcf; and United Fuel Gas Company, 142,502 Mcf.

Four wells were drilled by the A & R Oil Company about 4 miles south of Winterpock. This area is within the Richmond basin where Triassic sandtones, conglomerates, red shales, coal seams, and igneous dikes and sills of the Newark Group have been preserved in down-faulted blocks. These wells were drilled to shallow depths of from 114 to 620 feet.

During 1967 the Clinchfield Coal Company, division of The Pittston Company, sold 564,656 Mcf of gas to the Kentucky-West Virginia Gas Company and used 9390 Mcf in field operations, for a total of 574,046 Mcf. There was no drilling activity in the county during 1967.

A total of 3491 barrels of oil was produced in Lee County during 1967. Of this total, 1870 barrels were produced from 4 wells in the Rose Hill field and 1621 barrels from 2 wells in the Ben Hur field. In the Rose Hill field one old well was reworked without results, and two new wells, Josh Dean No. 2 and Ikie and Mary Bacon No. 2, were drilled to depths of 1856 and 1700 feet. These wells had not been completed by the end of the year.

The Ben Hur field, discovered in 1963, is located about 16 miles northeast of the Rose Hill field and was the scene of a small drilling boom during the spring and summer of 1967. Results to date have not substantiated the rumours that circulated during and after drilling of the James V. Graham No. 1. This well was started in 1966 and drilled to a total depth of 2525 feet early in 1967. Gas was encountered in the Trenton lime-

[1] Chief Geologist, Clinchfield Coal Company, division of The Pittston Company. Oliver W. Lineberg, State Oil and Gas Inspector, furnished production data.

Table 1. Summary of drilling in Virginia during 1967.

Operator	*Lease*	*Well No.*	*Total Depth (feet)*	*Initial Production (Mcf)*	*Final Production (Mcf)*	*Status* (12-31-67)
Chesterfield County						
A & R Oil Co.	Martin	1A	620	—	—	Incomplete
"	"	1B	482	—	—	"
"	"	2A	520	—	—	"
"	"	2B	114	—	—	"
Lee County						
Trans State Oil Ltd.	Josh Dean	2	1856	—	—	"
"	Bacon	2	1700	—	—	Drilling
Wilshire Oil Co. of Texas	Graham	1	2781	Show of oil and gas	—	Shut In
Trans State Oil Ltd.	"	2	2400	—	—	Shut Down
Wilshire Oil Co. of Texas	"	3	2734	—	—	Incomplete
"	Grace Cobb	1	2572	Show of oil	—	Testing
"	Livesay	1	800	—	—	Shut Down
Tazewell County						
Ray Bros. Corp.	Youngstown Mines	1	5490	253	400	On Line

stone at a depth of 2235 feet. A fire resulted and the rig burned down, leading to reports in local news media of a sensational gas volume. Eventually the well was acidized, and a small amount of oil (519 barrels) was produced during April and May, 1967. The well was subsequently deepened to 2781 feet without significant results.

A second well, the Dewey Livesay No. 1, was also started in 1966, but it encountered drilling difficulty at 800 feet and was still shut down. A third, the James V. Graham No. 2, was shut down after drilling to 2400 feet near the top of the Trenton. A fourth location, the James V. Graham No. 3, was drilled to 2734 feet; top of the Trenton limestone was at 2106 feet. No oil shows were reported. A fifth well, the Grace Cobb No. 1, was drilled to 2572 feet; the top of the Trenton was encountered at 2398 feet, and there was a show of oil at 2481 feet. The well was fractured and a pump installed; testing was incomplete.

The discovery well of the Ben Hur field, the Roy E. Bledsoe No. 1, was drilled in 1963 and produced 1102 barrels of oil during 1967. An offset to this well, the Wynn No. 1, was drilled to 2000 feet and abandoned in 1964 without drilling to the depth of the producing zone in the Bledsoe well.

There has been no drilling activity in the Bergton area of Rockingham County since the Shell Oil Company No. 1 R. J. Whetzel was abandoned at 14,176 feet in 1965. Two of the five shut-in Oriskany gas wells have been made available for local use, and an unknown, but probably small, amount of gas was produced during 1967.

A total of 2,281,830 Mcf of gas was produced in Tazewell County during 1967. Consolidation Coal Company produced 1,284,868 Mcf and United Fuel Gas Company, 996,962 Mcf. One new gas well was completed in Tazewell County by the Ray Brothers Corporation on their lease from the Youngstown Mines Corporation; total depth was 5490 feet. The Berea sand was encountered from 5320 to 5364 feet with an initial openflow of 253 Mcf. The well was shot with 1000 pounds of gelatin and 300 quarts of nitroglycerine, resulting in an increased openflow of 400 Mcf. The well is on the same lease as the Capito Youngstown Mines No. 1A. This well, drilled in 1966, had an initial openflow of 200 Mcf from the Berea sandstone. It was subsequently fractured and was shut down during 1967 awaiting further treatment or abandonment.

GEOGRAPHIC NAMES IN VIRGINIA

It is the purpose of the United States Board on Geographic Names to render formal decisions on new names, proposed changes in names, and names that are in conflict which are submitted for decision by individuals, private organizations, or government agencies. Communications about geographic names should be addressed to: J. O. Kilmartin, Executive Secretary, Domestic Geographic Names, U. S. Geological Survey, Washington, D. C. 20242.

An asterisk (*) preceding a name represents a change in an earlier decision; a dagger (†) preceding a name indicates modification of the text of a former decision.

†*Aquia Creek*: stream, 25 miles long, heads at 38°31′06″ N., 77°36′20″ W., flows southeast to the Potomac River 10 miles northeast of Fredericksburg; Stafford and Fauquier counties, Virginia; 38°23′30″ N., 77°18′45″ W. Not: Acquia Creek, Aquia Run.

**Bolton Branch*: stream, 2.5 miles long, heads at 38°48′27″ N., 78°10′05″ W., flows southeast to join Bearwallow Creek to form Hittles Mill Stream 3.7 miles northeast of Mount Marshall and 9 miles south-southeast of Front Royal; Rappahannock County, Virginia; 38°47′38″ N., 78°08′15″ W. Not: Burgess River (former decision), South Prong.

**Great North Mountain*: mountain ridge, trends northeast-southwest for 50 miles; its northeast end is 1.5 miles east of Gore, Virginia, and its southwest end is 3.5 miles southwest of the settlement of Orkney Springs, Virginia; Virginia-West Virginia; 39°15′45″ N., 78°18′15″ W. (northeast end), 38°45′45″ N., 78°52′15″ W. (southwest end). Not: Big North Mountain (former decision), Greater North Mountain, Greater North Mountains, North Mountain, North Mountains.

**Jordan River*: stream, 12 miles long, heads on the Blue Ridge at 38°46′15″ N., 78°10′15″ W., flows east to the Rappahannock River 14 miles southeast of Front Royal; Rappahannock County, Virginia; 38°45′36″ N., 78°01′42″ W. Not: South Fork Jordan River, South Fork Jordon River (former decision).

**Lamberts Point*: point of land, in the Elizabeth River in Norfolk; City of Norfolk, Virginia; 36°52′30″ N., 76°19′40″ W. Not: Lambert Point (former decision), Lambert's Point.

Lewis Run: stream, 5 miles long, heads at 38°18′-55″ N., 77°42′25″ W., flows southeast to join Brock Run to form the Ni River 2 miles south-southwest of Chancellorsville, Spotsylvania County, Virginia; 38°16′57″ N., 77°-38′47″ W. Not: Furnace Run, Lewis River, Scotts Run.

Moss Run: stream, 4.5 miles long, heads at 37°-47′05″ N., 80°10′30″ W., flows east to Dunlap Creek 2.5 miles southwest of Callaghan; Alleghany County, Virginia; 37°47′12″ N., 80°06′00″ W. Not: Mossy Run.

†*Mount Marshall*: mountain, consisting of two peaks, South Marshall, elevation 3212 feet, and North Marshall, elevation 3368 feet, on the Blue Ridge, in Shenandoah National Park 10 miles south of Front Royal; Rappahannock and Warren counties, Virginia; 38°46′-30″ N., 78°12′45″ W. Not: North Mount Marshall.

†*Ni River*: stream, 18 miles long, heads at the junction of Brock and Lewis runs at 38°16′-57″ N., 77°38′47″ W., flows southeast to join the Po River to form the Poni River 1.3 miles west of Guinea; Caroline and Spotsylvania counties, Virginia; 38°08′35″ N., 77°27′47″ W. Not: Ny River, Nye River.

North Marshall: peak, elevation 3368 feet, on Mount Marshall on the Blue Ridge, in Shenandoah National Park 10 miles south of Front Royal; Rappahannock and Warren counties, Virginia; 38°46′34″ N., 78°12′10″ W. Not: Mount Marshall.

Norton Prong: stream, 6 miles long, heads at 38°-17′20″ N., 77°47′25° W., flows southeast to join Robertson Run to form the Po River 6.5 miles north-northwest of Brokenburg; Spotsylvania County, Virginia; 38°13′48″ N., 77°44′20″ W. Not: Po River, Robertson Run.

†*Po River*: stream, 24 miles long, heads at the junction of Norton Prong and Robertson Run at 38°13′48″ N., 77°44′20″ W., flows east-southeast to join the Ni River to form the Poni River 1.3 miles west of Guinea; Caroline and Spotsylvania counties, Virginia; 38°08′35″ N., 77°27′47″ W. Not: Gladys Run.

Riles Run: stream, 8 miles long, heads at the northeast end of Supin Lick Mountain at 38°48′10″ N., 78°46′15″ W., flows northeast to Stony Creek 3 miles west-southwest of Columbia Furnace; Shenandoah County, Virginia; 38°52′14″ N., 78°40′58″ W. Not: Riley Run, Ryals Run.

South Marshall: peak, elevation 3212 feet, on Mount Marshall on the Blue Ridge, in Shenandoah National Park 10.2 miles south of Front Royal; Rappahannock and Warren counties, Virginia; 38°46′18″ N., 78°13′13″ W.

NEW PUBLICATION

A new LIST OF PUBLICATIONS is now available from the Division of Mineral Resources. This revision contains an up-to-date listing of the Division's publications and geologic maps, an index to these publications, and an index map to available topographic quadrangle maps in Virginia. The LIST OF PUBLICATIONS is available free of charge.

ADDITIONS TO STAFF

Mr. William S. Henika joined the Division staff on February 1, 1968, and is assisting with field investigations in the southeastern Piedmont. He received a B.A. degree in geology in 1965 and has completed requirements for the M.S. degree from the University of Virginia. During undergraduate and graduate training Mr. Henika worked with North American Exploration, Inc. and Johns-Manville, Ltd. in north-central Maine. He is interested in the igneous and metamorphic rocks of the Blue Ridge and Piedmont. Mr. Henika is married.

Mr. W. Edward Nunan was employed by the Division on February 1, 1968, and will assist in the transfer of published and unpublished geology to the new 7.5-minute topographic quadrangle maps. He received a B.A. degree in geology from Emory University in 1965 and is currently completing requirements for a M.S. degree. Mr. Nunan is married and has one daughter.

Virginia Division of Mineral Resources
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TOPOGRAPHIC MAPS

7.5-Minute Quadrangle Topographic Maps

Advance prints and revision compilations

Adequate maps published prior to January 23, 1968

Adequate maps published from January 23, 1968, to April 10, 1968

Big Island
Blackstone East
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Boyce
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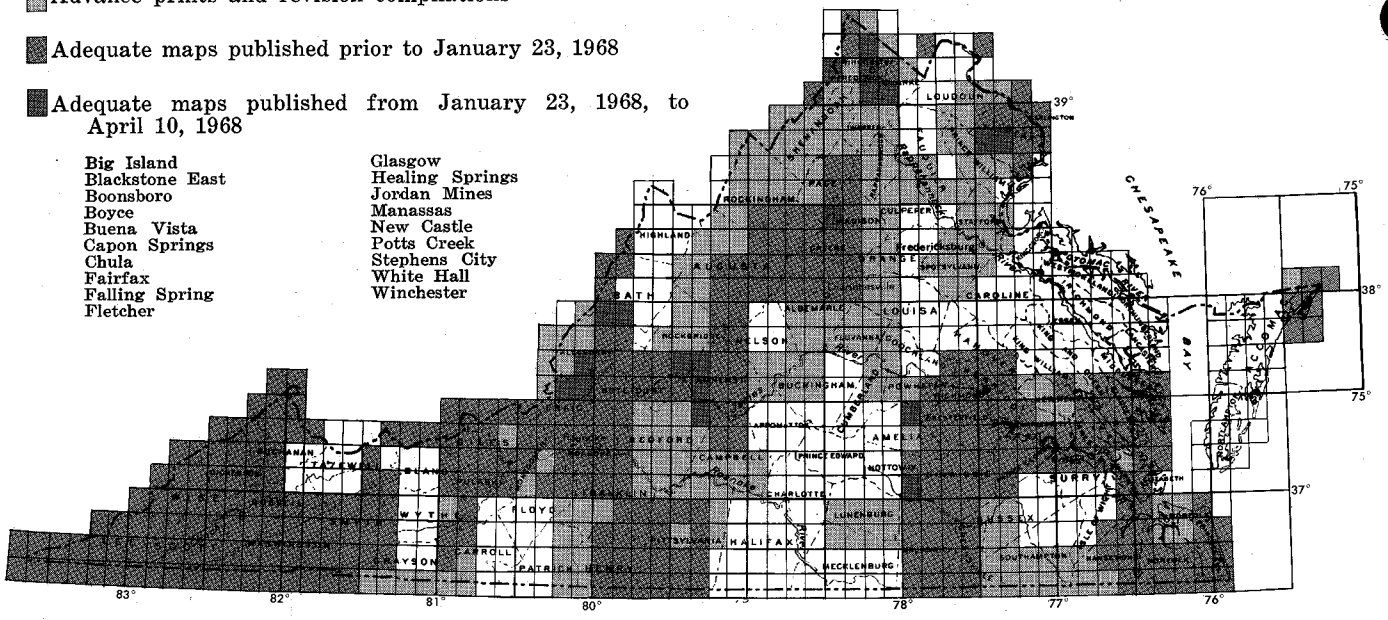
Capon Springs
Chula
Fairfax
Falling Spring
Fletcher
Glasgow
Healing Springs
Jordan Mines
Manassas
New Castle
Potts Creek
Stephens City
White Hall
Winchester



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Advance prints and copies of revision compilations are available at 50 cents each from the U. S. Geological Survey, Topographic Division, 1109 N. Highland St., Arlington, VA 22210.

PUBLISHED MAPS

State index is available free. Published maps are available at 50 cents each from the Virginia Division of Mineral Resources, Box 3667, Charlottesville, VA 22903.